2011. The Journal of Arachnology 39:495–496

SHORT COMMUNICATION

Egg hiding in four harvestman species from Uruguay (Opiliones: Gonyleptidae)

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Abstract. I describe oviposition sites and egg-hiding for four species of the family Gonyleptidae: *Parampheres bimaculatus*, *Parampheres ronae* (Gonyleptinae), *Discocyrtus prospicuus*, and *Pachyloides thorellii* (Pachylinae). Females of *P. bimaculatus* bury single eggs on the ground; the first record of this behavior among gonyleptids. Females of the other three species lay their eggs, singly or in clusters, on tree trunks or rock fissures. I found the eggs of *P. ronae* and *D. prospicuus* covered with debris, whereas eggs of *P. thorellii* were not. Females of *D. prospicuus* and *P. thorellii* lay their eggs over an extended period of time. At least for hemipterans, covering the eggs with debris works as a way to camouflage or prevent egg dehydration. I hypothesize that for the species used in this study, to spread isolated eggs in time and space may also protect them against predators and parasites.

Keywords: *Discocyrtus*, *Parampheres*, *Pachyloides*, egg burying, oviposition, parental care

Many cases of post-ovipositional maternal care and post-ovipositional paternal care have been described for representatives of the Neotropical Gonyleptidae in the last two decades (Machado & Macías-Ordóñez 2007). Although egg-hiding is regarded as the most common form of parental care in the family (Machado & Raimundo 2001), there are few descriptions of this behavior in the arachnological literature. In this study, I describe oviposition sites and egg-hiding for four species of the family Gonyleptidae without post-ovipositional parental care. Reproductive behavior of two species, *Parampheres bimaculatus* (Mello-Leitão 1932) and *P. ronae* (Mello-Leitão 1927) (Gonyleptinae), previously undescribed, and reproductive behavior of the remaining two, *Discocyrtus prospicuus* (Holmberg 1876) and *Pachyloides thorellii* (Holmberg 1878) (Pachylinae), has only been briefly mentioned by Canals (1936).

All species were collected during February 2009. *Parampheres bimaculatus, D. prospicuus*, and *P. thorellii* were collected in two localities, Marindia (34°46′S, 55°49′W) and Piedras de Afilar (34°45′S, 55°33′W), both in the Department of Canelones; *P. ronae* was collected in Cerro Verde (33°56′S, 56°30′W) in the Department of Rocha, eastern Uruguay. I found the individuals during daylight, under rocks and rotten trunks located in grassland landscapes. I placed collected animals in four different terraria (40 × 20 cm base, 20 cm height), one for each species (13 *P. bimaculatus* (9 female, 4 male), 12 *P. ronae* (9 female, 3 male), 15 *D. prospicuus* (10 female, 5 male), and 17 *P. thorellii* (10 female, 7 male)). All terraria contained sand and soil as substrate, cotton embedded with water as a water source, and rocks and pieces of wood to provide a variety of refuges for the individuals. All the individuals were fed pieces of larvae of *Tenebrio mollitor* (Coleoptera, Tenebrionidae), dead adults of *Acheta domesticus* (Orthoptera, Gryllidae), apple and cucumber, once a week. Behavioral data were based on daily opportunistic observations made during the afternoon (15:00–18:00 h) in June 2009 at room temperature (15.0 ± 1.6° C, mean ± SD) under natural light. Voucher specimens were housed in the Colección Entomológica of the Facultad de Ciencias, Montevideo, Uruguay.

I observed one *P. bimaculatus* female oviposit three times on the same day. First, the female walked around touching the substrate with the tarsus of her first pair of legs and stopped at an isolated place. Standing on that place, she repeatedly touched a point in the substrate with the dorsal part of the tarsi of the first pair of legs, and occasionally with the same part of the metatarsi of the same pair of legs. Through these movements with the first pair of legs, which lasted ~ 4 min, the female dug a small hole on the ground (ca 0.5 cm diam.). Next, she remained quiescent for approximately 5 min, and then everted her ovipositor. In this position, the female touched the ovipositor using the first pair of legs for nearly 3 min before laying an egg inside the hole in the ground. Finally, remaining still on that place, the female used her first pair of legs to drag little pieces of wood and other particles of the substrate towards the egg until it was completely buried (this behavior lasted ~ 7 min), and then she abandoned the oviposition site. This same female walked around for nearly 5 min and resumed the same behavioral sequence described above, which ended with another egg buried in the ground 5 cm from the first egg. Five minutes later, a third egg was laid 5 cm from the second one and the oviposition behavior followed the same general pattern described for the first egg. The female did not coat any of the eggs with mucus. I recorded one egg cannibalism event in this species: an adult male dug up and ate one of the eggs laid earlier that day.

During the observation periods, two *P. ronae* females laid one egg each inside fissures of a piece of wood. Both observations started when I noticed the females with the everted ovipositor having an egg on its apex. Ovipositing females remained in this position for ~ 3 min and then lowered the anterior region of the body, depositing the egg inside the fissure. In the sequence, females retracted the ovipositor and used mostly the second (but also the first pair of legs) to cover the eggs with debris, such as sand grains and particles of dust, wood, or soil. During the egg-covering process, females scraped the substrate around the fissure, picked up debris, and gently attached particles to the egg surface. They did not coat the egg with mucus, as described for other gonyleptid species (Machado et al. 2004). Once each female covered the egg completely, she left the oviposition site. In addition to these two oviposition events for this species, I found in the terraria both isolated eggs ($n = 8$) and small clusters ($n = 2$) of up to six eggs on pieces of wood, all of them covered with debris.

For *D. prospicuus* ($n = 6$) and *P. thorellii* ($n = 30$), I did not observe oviposition behavior, but I found eggs inside the terraria. No *D. prospicuus* egg was coated with mucus, but I found all of them covered with debris. I located five individual eggs each inside rock fissures and one small cluster of five eggs spaced out by 0–1 cm on the bottom of a piece of wood. Females of *P. thorellii* always laid isolated eggs on the wet cotton wool ($n = 20$), inside fissures in pieces of wood ($n = 7$), or under rocks ($n = 3$). In contrast to Canals's (1936) observations, I never found eggs of this species covered with debris.

Egg-burying described for *P. bimaculatus* females probably represents the first record of this behavior in the family Gonyleptidae. Although eggs buried in the ground are more likely to be protected

from predators than eggs laid on exposed surfaces, a cannibalism event by an adult male was registered. Observations in nature are necessary to confirm this behavior as it is based in only one event.

The oviposition behavior I describe for *P. ronae* is similar to other Gonyleptinae species that do not engage in parental care, such as *Mischonyx cuspidatus*, the females of which lay isolated eggs on the soil and under fallen trunks (Pereira et al. 2004). To cover the eggs with debris, however, seems to be a widespread behavior within this subfamily because it is observed even in species with post-ovipositional paternal care, such as *Gonyleptes saprophilus* and *Neosadocus* sp. (Machado et al. 2004).

Among the subfamily Pachylinae, which comprises nearly 400 species (Kury 2003), there are records of post-ovipositional maternal care and egg-hiding. Post-ovipositional maternal care in the group is always associated with clustered oviposition, whereas egg-hiding is always associated with oviposition of isolated eggs (Machado & Raimundo 2001). Independent of the form of parental care, most pachyline species cover the eggs with debris, which is generally interpreted as a way to camouflage or prevent egg dehydration (Willemart 2001; Elpino-Campos et al. 2001). However, as described in this study, *P. thorellii* does not cover the eggs. This species inhabits extremely humid places where there almost no light or air currents exist; such habitat conditions are different from those of the other species studied here. Therefore, future studies should focus on evaluating these differences in order to find the possible cause of *P. thorellii*'s unique behavior among members of its subfamily.

At least for hemipterans, the act of hiding eggs by depositing them either at varying times or in different locations is probably as efficient as post ovipositional maternal care in ensuring that the eggs are protected against predators and parasites (Tallamy & Schaefer 1997). Since individuals of both *D. prospicuus* and *P. thorellii* can be found living syntopically with individuals of *Acanthopachylus aculeatus*, the females of which exhibit post-ovipositional maternal care (Capocasale & Bruno-Trezza 1964; Toscano-Gadea 2008), it would be interesting to compare offspring survival in these species to test the efficiency of different forms of parental care in harvestmen.

I thank Carlos A. Toscano-Gadea for helping me take care of the individuals, for the constant support, and for the useful comments and suggestions on this work. I would also like to thank Anita Aisenberg for critically reading the manuscript. Finally, I would like to thank both reviewers whose comments significantly improved this work.

LITERATURE CITED

Canals, J. 1936. Observaciones biológicas en arácnidos del orden Opiliones. Revista Chilena de Historia Natural 40:61–63.

Capocasale, R. & L.B. Bruno-Trezza. 1964. Biología de *Acanthopachylus aculeatus* (Kirby, 1819), (Opiliones: Pachylinae). Revista de la Sociedad Uruguaya de Entomología 6:19–32.

Elpino-Campos, A., W. Pereira, K. Del-Claro & G. Machado. 2001. Behavioral repertory and notes on natural history of the Neotropical harvestman *Discocyrtus olivierioi* (Opiliones: Gonyleptidae). Bulletin of the British Arachnological Society 12:144–150.

Kury, A.B. 2003. Annotated catalogue of the Laniatores of the New World (Arachnida, Opiliones). Revista Ibérica de Aracnología, volumen especial monográfico 1:1–337.

Machado, G. & R. Macías-Ordóñez. 2007. Reproduction. Pp. 414–454. *In* Harvestmen: the Biology of Opiliones. (R. Pinto da Rocha, G. Machado & G. Giribet, eds.). Harvard University Press, Cambridge, Massachusetts.

Machado, G. & R.L.G. Raimundo. 2001. Parental investment and the evolution of subsocial behaviour in harvestmen (Arachnida: Opiliones). Ethology Ecology and Evolution 13:133–150.

Machado, G., G.S. Requena, B.A. Buzatto, F. Osses & L.M. Rossetto. 2004. Five new cases of paternal care in harvestmen (Arachnida: Opiliones): implications for the evolution of male guarding in the Neotropical family Gonyleptidae. Sociobiology 44:577–598.

Pereira, W., A. Elpino-Campos, K. Del-Claro & G. Machado. 2004. Behavioral repertory of the Neotropical harvestman *Ilhaia cuspidata* (Opiliones, Gonyleptidae). Journal of Arachnology 32:22–30.

Tallamy, D.W. & C. Schaefer. 1997. Maternal care in the Hemiptera: ancestry, alternatives, and current adaptive value. Pp. 94–115. *In* The Evolution of Social Behavior in Insects and Arachnids. (J.C. Choe & B.J. Crespi, eds.). Cambridge University Press, Cambridge, UK.

Toscano-Gadea, C.A. 2008. Descripción del cuidado maternal en *Acanthopachylus aculeatus* (Opiliones, Gonyleptidae). Libro de resúmenes del Segundo Congreso Latinoamericano de Aracnología.

Willemart, R.H. 2001. Egg covering behavior of the Neotropical harvestman *Promitobates ornatus* (Opiliones, Gonyleptidae). Journal of Arachnology 29:249–252.

Manuscript received 31 December 2010, revised 26 April 2011.